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COMPLIANT IN A MOMENT: A COMMENTARY ON NEVIN

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Nevin's scholarly and timely discussion attempts to maintain the precarious union of the experimentally derived theory of behavioral momentum with applications of the behavioral momentum construct to human subjects in applied settings. Nevin's discussion adds much-needed clarification to a process that at times has proven to be awkward for applied researchers. In this commentary, we will address three general questions: (a) Can the applications of behavioral momentum be derived from the theory as conceptualized by Nevin? (b) Could those applications have been developed had the theory not been formulated? (c) Does behavioral momentum theory add significantly to the compliance literature?

DESCRIPTORS: behavioral momentum, metaphor, friction, establishing operations, compliance

In that this is a journal of *applied* behavior analysis, we will not be questioning the scientific validity of the theory of behavioral momentum. Instead, we will address issues concerning its metaphoric role in prompting applications. We will address three questions in our comment: (a) Can the applications of behavioral momentum be derived from the theory as conceptualized by Nevin? (b) Could those applications have been developed had the theory not been formulated? (c) Does behavioral momentum theory add significantly to the compliance literature?

Breaking Down a Metaphor

In physics, momentum equals velocity times mass, and is a property of an object. Velocity is measured more or less directly by observing position at different points in time. Mass is inferred from weight in a known gravitational field, or from other known properties such as the volume of a known density. Note that velocity and mass are based on different observations.

In behavior, momentum is defined as the product of velocity and mass, where velocity is the rate of response and mass is (a) inferred from acceleration under known conditions and (b) a function of the frequency of reinforcement in the presence of a given stimulus. Momentum is a property of a relationship—the discriminated operant (three-term contingency)—not of a single entity. On the measurement level, both velocity and mass are based on position-based measures: rate and acceleration of response. Nevin claims that mass is a function of rate of reinforcement, not rate of response, but still infers it from changes (usually deceleration) in response rate.

To date, we have seen no mention of friction within the momentum model despite the role it plays in applications of classical mechanics. Response cost (i.e., any property or consequence of responding that may reduce or punish it; Catania, 1992) could be said to play a role in behavioral momentum that is analogous to that of friction in physical momentum. *Friction* is an opposing force tightly bound (in a sense *internal*) to the event carrying the momentum. This is supported by the well-known aversiveness of high fixed-ratio reinforcement schedules, in which responding on the schedule itself ac-

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quires the properties of an aversive stimulus. By our interpretation, both Lattal (1989) and Elsmore (1971) can be read in terms of supporting the response-cost/friction metaphor and an intrinsic opposing force that is functionally similar to friction or air resistance in physics. This is consistent with the momentum analysis of high- and low-probability compliance procedures.

An examination of the requests used in behavioral momentum applications suggests topographical differences in responses to those requests. The low-*p* prompted behaviors usually involve considerably greater response cost than do the high-*p* requests, which are often prompted single-step requests (e.g., "give me five") rather than the multistep low-*p* requests (e.g., "put your toys away"). In the compliance literature, the amount of effort required to perform a requested task is directly linked to the latency to the first response as well as time to completion. Response cost should be a vital measure when considering behavioral momentum, in that it plays an unavoidable role in the likelihood of compliance (e.g., high-*p* = "look at me," "touch your nose," "stand up"; low-*p* = "hand me that piano"). If we incorporate the concept of friction, the notion that a high-*p* environment can overcome the response cost of the low-*p* request seems more intuitively consistent with the behavioral momentum metaphor.

Coercing a Metaphor

The difficulties in the application of behavioral momentum begin with the discrepancy in schedules of reinforcement that are used in applications compared to those used in the laboratory (Plaud & Gaither, 1996). Nevin notes the convenience of multiple schedules of reinforcement in evaluating resistance to change of one discriminated operant relative to another. Mace et al. (1988) and nearly all others who have applied the high-*p* process have begun with a presumed intermittent schedule of reinforcement (i.e., preexisting compliance at high or low rates), which is then converted to a continuous schedule of reinforcement (CRF) to increase velocity and mass. Mace's application does not compare the high-*p* behaviors to another behavior (Plaud & Gaither, 1996). Also, Nevin describes the use of time-out to functionally separate the components of a multiple schedule. This could account for the greater effectiveness of the 5-s interprompt time (IPT) versus the 20-s IPT in Mace's study, in that behavioral momentum is most effective as a multiple-schedule interaction.

Pigeon pecks in Nevin's experiments are analogous to Mace's high-*p* sequence. However, Nevin measures resistance to change, whereas Mace measures change, not of the high-*p* behavior but rather of the low-*p* response behavior. (Note that Nevin's implication that, for applied work, resistance to change in the therapy setting is a function of outside reinforcer rates is not unique to behavioral momentum theory.) Although Mace links low-*p* and high-*p* requests via a common higher order response class, Nevin conceptualizes the low-*p* request as a disrupter (analogous to prefeeding or free feeding). The high-*p* sequence, which emulates the dependent variable in Nevin's research and is vital to his theory, is nearly ignored by researchers applying behavioral momentum who instead choose to focus their analysis on the low-*p* responses (i.e., Mace's dependent variable is Nevin's disrupter).

The subjects in behavioral momentum research have a history of near-perfect compliance with selected high-*p* requests. Roberts (1985) noted difficulty in getting children with a history of compliant responses to specific requests not to comply with them. Still, increasing the frequency of prompting (CRF) followed by reinforcement (usually social praise) is said to increase velocity and mass. We are left to assume that the high-*p* responses are maintained at a near-perfect level, but in general we aren't given that information. When we examine research that similarly superimposes a CRF schedule upon an existing intermittent schedule in an effort to treat a behavior such as human stereotypy (e.g., Foxx & McMorrow, 1983; Neisworth, Hunt, Gallop, & Madle, 1985), we do not see a strengthening of response rate; rather, the rate stays the same or even declines in some cases in which there are competing reinforcers. When reinforcement is withdrawn, the behavior (stereotypy) dramatically decreases. The results of these studies would have predicted the results of similar behavioral momentum studies (e.g., Zarcone, Iwata, Hughes, & Vollmer, 1993; Zarcone, Iwata, Mazaleski, & Smith, 1994) whereas behavioral momentum theory does not. Instead Nevin rationalizes Zarcone et al.'s (1994) failure to obtain compliance by suggesting that self-injurious behavior is more disruptive than the disrupter (i.e., low-*p* request). His point is well taken, but there is a need for further empirical investigation of this discrepancy.

Cohen, Riley, and Weigle (1993) have also suggested that multiple-schedule effects may not be shown in a single schedule. This appears to restrict the generalization of experimental findings to applied settings. It takes a considerable reach to interpret the applied work as constituting a multiple schedule, including expanding the time scale to that of a radically molar analysis. This is certainly possible, but in the absence of data to support it, this interpretation seems to be a bit of a deus ex machina. If the generality of behavioral momentum survives the free versus signaled operant distinction and simple versus multiple schedules of reinforcement debate, the metaphor may in fact lose meaning. If direct rate measures are no longer necessary, are we simply basing an analysis on the relative likelihood of reinforcement occurring at some future point in time, and saying that more likely reinforcers produce more resistance to disruption?

The therapist-experimenter in the applied studies of behavioral momentum is analogous to the colored lights used by Nevin in the laboratory, thus adding a potential confounding effect. It might be that the applied situations that have been labeled behavioral momentum are in fact manipulating an establishing condition. In using existing stimulus control to prompt a high-*p* response and the subsequent delivery of reinforcement, the person presenting the prompt is established as a source of reinforcement, subsequently strengthening behaviors controlled by that type of reinforcement (Catania, 1992). Only Davis, Brady, Williams, and Hamilton (1992) have alternated therapists, and that was across conditions. To test or neutralize the impact of the prompter, experiments should alternate therapists across trials or have separate therapists deliver prompts and reinforcement (especially because social praise is the preferred reinforcer).

If behavioral momentum applications are actually manipulating establishing conditions, this would explain the results of Kennedy, Itkonen, and Lindquist (1995) and Carr, Newsom, and Binkoff (1976) in that they produced results similar to the high-*p* sequence using social comments or stories. Nevin appears to suggest that Carr et al.'s results occurred because the subject was told amusing stories. However, in their study, Carr et al. had already established that several other conditions (e.g., free time or tacts) besides storytelling could reduce or eliminate SIB. Their storytellers were not told to tell amusing stories, but were instead told to deliver the story in an animated, cheerful manner. This suggests that the storyteller may have been a more likely source of reinforcement than the story. That an explanation based on establishing operations might better describe what is actually happening does not necessarily contradict a behavioral momentum analysis; rather, it demonstrates that other less involved constructs may be used to systematize the compliance literature. Establishing operations are also not dependent upon the existence of a multiple schedule and put more emphasis on the stimulus control aspects of a behavior that is controlled by prompts, which is consistent with the high-*p* procedure.

Applying a Metaphor

To date, we count about 280 articles, books, and chapters depicting successful treatments of compliance and noncompliance. Much of this literature in the 1990s is a direct or indirect result of Mace's intriguing application of the behavioral momentum process with human subjects (Mace et al., 1988).

Mace et al. (1988) issued a sequence of high-*p* requests that were then followed (either after 5 s or 20 s) by a request with which their subject had demonstrated a low probability of compliance. The model of starting with a prompt to which a subject is likely to respond is not new; it can be found in the preexisting compliance literature in much of the work done by Forehand and by Neville and Jenson (1984). The high frequency of compliant responses within 5 s and the tendency for these responses to diminish after about 20 s were first noted by Weiss (1934) and again later by Stiffman (1982).

"Don't" requests have been troublesome to compliance researchers, both because of class-specific effects (Neef, Shafer, Egel, Cataldo, & Parrish, 1983) and because they rely on environmental stimuli as opposed to a prompt given by the experimenter. Consequently, unlike "do" requests, the unwanted ("don't") behavior precedes the high-*p* sequence, which almost certainly interrupts it. Compliance in this case involves the strengthening of a response class defined by exclusion. This presents a problem for the behavior therapist because it requires calculating the rate of response of a class of behaviors that includes everything *except* the target behavior. In addition, "don't" requests involve an individual's history of aversive control. Once again, the therapist has previously been established as a source of positive and aversive control. This is consistent with an establishing operations analysis of the function of high-*p* requests.

The potential confounding effects in the "don't" request behavioral momentum literature are too numerous to mention in a space-limited comment; however, it is our contention that the most cogent evidence of behavioral momentum when applied to "don't" is not the termination of a behavior but rather the amount of time elapsed (or latency) before the behavior is engaged in again. No behavioral momentum study to date has focused on this measure.

A review of the applied behavioral momentum literature indicates a dearth of follow-up information. Therefore, we cannot properly evaluate temporal generalization at this juncture. We could not find applications of behavioral momentum that sought to measure generalization of the results to requests that occur naturally in applied settings. This seems to be a natural concern given the stated intention, momentum. There have been no attempts to sort out potential therapist confounding variables (e.g., eye contact, proximity, tone or volume of voice, etc.) that could contribute to velocity. These are all examined in the preexisting literature on compliance. In fact, Englemann and Colvin's (1983) hard task procedure and Carr et al.'s (1976) process of embedding requests are often cited as examples that support behavioral momentum, despite the fact they existed in the compliance literature well before the high-*p* procedure was introduced. Another point worth noting is that almost all high-*p* applications use forms of social praise as reinforcement for compliance (no doubt due to the temporal constraints of the request sequence) despite research by Roberts (1985) and Forehand (1986) clearly showing that this type of reinforcement is ineffectual in treating this disorder. We might ask ourselves, "Where is the *mass* coming from?"

In all, Mace's work has been a significant addition to the compliance literature. However, it might be a disservice to inextricably link the high-*p* sequence to behavioral momentum in that the metaphor's greatest value might lie in interventions outside the treatment of noncompliance.

Seduced by a Metaphor

It is our opinion that Nevin's primary contribution has been to call our attention to the importance of the *second* derivative of the position of an event: acceleration. The first derivative of the function representing the position of an event is of course velocity (in statistics the corresponding measures would be the moments of a frequency distribution). What Nevin has pointed out is that acceleration and deceleration are under the control of different variables than velocity. This is an extremely valuable contribution to our science, but given the number of theoretical and experimental questions that Nevin acknowledges are still open, the use of this model to dictate application might be premature.

Mace's development of the high-*p* procedure is innovative enough to stand alone outside of the expanding umbrella of behavioral momentum. What disturbs us is that behavioral momentum is being pushed into the realm of a prescriptive compliance-based program due to its perceived link with the high-*p* procedure (see Davis & Brady, 1993, for an example). These programs do not comfortably fit Nevin's model, a point that Nevin appears to at least leave open when he states that "translating the terms of the metaphor . . . entails a fair amount of speculation" (p. 544). Because the most significant contribution of behavioral momentum theory is its separation of the persistence of behavior (e.g., resistance to extinction) from its velocity (e.g., rate of response), one would expect that applied extensions of the theory would be to situations in which a freely occurring operant was to be made more or less resistant to disruption. This was the case in Mace, Lalli, Shea, and Nevin (1992), in which a basketball team's favorable reaction to adversity increased as a function of the rate of reinforcement for that behavior. This might be the best example of behavioral momentum in the applied literature.

Another concern is the tendency to draw supporting evidence for this model from research that predates Nevin's use of the term. The study by Carr et al. (1976) is often held up as an example of applied research supporting the concept of behavioral momentum. But it is important to note that Carr et al. drew parallels between their research and the counterconditioning studies of Jones and Wolpe. Are we to now conclude that Jones used the behavioral momentum process in treating Peter's generalized fear of white fluffy objects (Jones, 1924)? Should we go to our behavioral research methods texts and cross out *carryover effects* and instead write in *behavioral momentum effects*?

Nevin acknowledges both the danger and intrigue of applying metaphors. He also acknowledges their value in fostering innovative techniques and applications. We do not deny that this metaphor has produced many applications with high degrees of social validity; it has. Whether responding to high-*p* and low-*p* prompts are both members of the higher order operant *compliance,* and whether therefore reinforcement of one subsequently increases the mass and hence momentum of both, remains to be settled empirically. Lacking a definite resolution, we are left with face-valid conjecture and a system that can account for virtually anything on a post hoc basis. This is a key concern regarding the applicability of behavioral momentum to compliance.

Finally, behavioral momentum bears a disquieting formal resemblance to Hull-Spence *habit strength* (Anderson, 1978; Glaser, 1982), which also separated the strength of behavior into a response component based primarily on frequency (stimulus-response pairings) and a motivational component based on reinforcement (D·K: the sum or product of drive and incentive motivation). This was an attempt at a global theory accounting for all types and levels of behavior. With the addition of constants and exponential variables as necessary, habit strength could be made to fit any new observation. As a result, however, it became less productive in predicting new categories of outcomes. Subsequently, classical learning theories shifted to a type of theory that dealt with a more restricted domain. We hope that, through careful empirical investigation, replication, and provocative discussion, we will not repeat the mistakes of the past.

Both Nevin and Mace deserve much credit for their scholarly work in developing and applying the process of behavioral momentum. Few research efforts generate so much empirical work and lively debate within so short a period of time. We are not interested in discrediting the work done using behavioral momentum; rather, we seek a framework within which it comfortably fits. Nevin's discussion adds much clarity at a very crucial juncture, while at the same time leaving intriguing questions for future researchers to ponder.

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